



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of: Brueckner et al.

Serial No.: 09/900,251

Group No.: 1743

Filed: July 6, 2001

Examiner: B. Sines

For: SPATIAL COORDINATION SYSTEM

**APPELLANTS' BRIEF UNDER 37 CFR §1.192**

Mail Stop Appeal Brief  
Commissioner for Patents  
PO Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

**I. Real Party in Interest**

The real party and interest in this case is Environmental Research Institute of Michigan, by assignment.

**II. Related Appeals and Interferences**

There are no appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

**III. Status of Claims**

The present application was filed with 55 claims. Claims 41-55 were canceled by amendment in December 2004. Claims 1-40 are pending, rejected and under appeal. Claims 1, 21 and 34 are independent claims.

**IV. Status of Amendments Filed Subsequent  
Final Rejection**

No after-final amendments have been filed.

## **V. Summary of Claimed Subject Matter**

Independent claim 1 is directed to system for constraining the movement of a walker in a digital space with respect to some distinguished location in the space. The system comprises a pump software component and a walker software component. The pump software component is associated with the distinguished location, emitting a digital pheromone to generate a pheromone gradient with a rate of evaporation and a rate of propagation. The walker software component operates in a grid system within the space, and includes a pheromone sensing threshold. The walker component moves within the space to satisfy a preselected constraint with respect to the pump. (*See, for example*, Specification, page 25, line 14 to page 45, line 25; Figure 12, 20 and 21).

Independent claim 21 provides resides in a process for constraining the movement of a walker software component in a digital space with respect to some distinguished location in the space. The method comprises the steps of emitting a digital pheromone from a pump to generate a pheromone gradient having a rate of evaporation and rate of propagation, and moving the walker within the space in response to the pheromone gradient to satisfy a preselected constraint relative to said pump. (*See, for example*, Specification, page 25, line 14 to page 45, line 25; Figure 12, 20 and 21).

Independent claim 34 sets forth a system for constraining the movement of a walker software component in a digital space with respect to some distinguished location in the space. The system comprises a pump software component, a plurality of distance software agents created by said pump around a pump location, and a walker software component. The distance agents deposit distance pheromones having local concentrations forming a distance profile, while the walker operates in a grid space of polytopes that samples the distance profiles to satisfy a preselected constraint relative to the pump. (*See, for example*, Specification, page 25, line 14 to page 45, line 25; Figure 12, 20 and 21).

## **VI. Grounds of Objection/Rejection To Be Reviewed On Appeal**

1. The rejection of claims 1-40 under 35 U.S.C. §112, first paragraph.

## **VII. Argument**

Claims 1-40 stand rejected under 35 U.S.C. §112, first paragraph, as failing to comply with the

enablement requirement.<sup>1</sup> The Examiner has listed numerous factors on page 2 of the Final Office Action. Each will be addressed in turn.

(1) The Breadth of the Claims.

The Examiner believes that the specification "does not adequately disclose a specific pump system, pheromone, walker apparatus, type of sensor or control system." Based upon this premise, "a person of ordinary skill in the art is not enabled to make and use the entire scope of the claimed invention without undue experimentation." Appellant respectfully disagrees. Each one of these objects is described *extensively* in the specification. For example:

"The present invention details a pheromone-based coordination mechanism of agents on a hexagonal grid. Agents of two species live in places on the grid: pumps and walkers. Pumps regularly deposit pheromones at their current place. Potentially, they are able to move independently over the grid, but in this paper, we consider static pumps only. The walkers seek to occupy the same places as the pumps, but do not perceive them directly or know the purpose of their movements. Walkers are only permitted to sample pheromone concentrations at their current place and their immediate neighbors." (Specification, page 7, lines 12-19)

From this introduction, the specification goes on to detail *exactly* how each component operates and functions. With regard to "type of sensor or control system,"

"In the preferred embodiment, a "pheromone" is a packet of digital information that includes at a minimum two pieces of information: a type identifier enabling different packets of the same type to be associated with one another, and a strength. It will be apparent to one skilled in the art that non-digital embodiments, such as chemical deposits with distinguishable composition (corresponding to the type) and concentration (corresponding to the strength), are also possible and fall within the purview of the invention. The different pheromone configurations emitted by each target provide a gradient between long range detection and short range accuracy of guidance. A protocol is provided herein to determine the optimal set of pheromone configurations for a given problem as well as a method of local information content estimation such that a decision maker may decide which pheromone signal should guide target seeking behavior at any given time." (Specification, page 2, lines 14-25)

The problem is *not* that Appellant has failed to enable a person of ordinary skill in the art, but rather, that the Examiner has failed to properly interpret the language of the claims. The Examiner is

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<sup>1</sup> Although the Examiner "rejects" claims 47 and 48 they were cancelled by amendment.

treating “sensors” and “control systems,” for example, as discrete pieces of hardware but they are not; rather, they refer to functions performed by software components in a digital space.

The Board will note that independent claims 1, 21 and 34 have been amended to limit the implementation to software components executed in a purely digital environment. Although, as explained on page 2 of the specification, that non-digital environments, such as chemical deposits with distinguishable composition, are also possible and fall within the purview of this invention, in the preferred embodiment, a “pheromone” is a packet of digital information. Likewise, the other components in this particular embodiment are pieces of software, or applets, that execute in a distributed digital computational environment. Such distinction would be readily apparent and enabling to one of ordinary skill in the art.

#### (2) The Nature of the Invention.

Here the Examiner contends that the lack of prior art provides evidence as to the high degree of unpredictability, and asserts that it is unclear how the pump system, walker apparatus and associated sensor system are cooperatively associated. With regard to the first point, enclosed and made of record as part of a supplemental information disclosure statement, are a dissertation from one of the inventors, namely, Mr. Bruckner, entitled “Return from the Ant”; an article co-authored by another one of the inventors, Dr. H. VanDyke Parunak entitled “Digital Pheromones for Autonomous Coordination of Swarming UAV’s”; and an article authored by the inventors Bruckner and Parunak entitled “Multiple Pheromones for Improved Guidance.” Such materials were intended to provide the Examiner with a greater foundational understanding as to the genesis of this invention.

Although research into digital “ants” and digital “pheromones” and the like, is limited to a rather select intellectual community, the fact that previous papers have been written in regard to this subject, along with conferences wherein information has been presented on these topics, should demonstrate that there is a high degree of predictability in this field of endeavor. The Board is invited to peruse, for example, at least the section entitled “An Agent System – Pheromone Architecture,” which begins on page 25 of the specification, to the bottom of page 45, wherein pumps, walkers and pheromone activities are described.

(3) The State of the Prior Art

Again, given the background materials submitted herewith, the specification as filed does indeed offer sufficient direction or guidance required to meet the enablement requirement under MPEP §2164.05(a).

(4) The Level of Skill of One of Ordinary Skill in the Art.

Applicant respectfully disagrees that the specification fails “to bridge the gap between the level of skill of one of ordinary skill in the art as evidenced by the prior art.” Again, although those familiar with these types of inventions represent a relatively small community, those within that community do, nevertheless, share a common understanding about the genesis of this particular type of subject matter.

(5) The Level of Predictability in the Art.

Appellants believe this was discussed under (2), above, *The Nature of the Invention*. The Board is urged to read the instant specification in view of the various previously submitted prior-art references to gain a more profound understanding as to the nature of the invention and the level of predictability in the art.

(6) The Amount of Direction Provided by the Inventor.

Appellants disagree that the specification needs to provide more direction and guidance as to how to make and use the claimed invention. In particular, the Examiner claims that it is unclear how the pump and system and walker apparatus are cooperatively associated, which would enable the claimed system to operate properly. In view of the amendments submitted herewith, limiting the implementation to a digital environment including digital pheromones and agents, and so forth, in the form of software components, Applicant believes all of the requisite conditions have been met. To one of ordinary skill in the art, even without a thorough understanding of digital ants and the like, given the extensive detailed description of the way in which the various components interact, it would be well within the purview of one of ordinary skill in the art to implement a system without undue experimentation.

(7) The Existence of Working Examples.

Appellants disagree that the invention is not disclosed in such a manner that one skilled in the art would be able to practice the claimed invention without undue experimentation. Indeed, the Appellants *have* implemented working systems, and contend that others of skill in the art would be able to do the same. Regarding the Examiner's questions regarding volatile chemical compounds, gas sensors, and spectrophotometers, and the like, these concerns should be rendered moot in view of the amendment submitted herewith.

(8) The Quantity of Experimentation Needed to Make or Use the Invention Based Upon the Content of the Disclosure.

The Examiner's concerns about the need to set up some type of chemical environment in order to implement physical pheromones, hardware sensors/detectors and the like, should now be put to rest. Given that all of the various components interact within a digital computing environment, one of ordinary skill in the art would clearly know how to implement these features. As discussed above, independent claims 1, 21 and 34 have been amended to limit the implementation to *software components* executed in a purely digital environment; i.e., in a computer or distributed computing environment. Given that the "pump" and "walker" components are software objects, one of skill in the art of computer science would be enabled by providing the components with the functional capabilities set forth in the claims. The term "pheromone" should not be taken to mean "a chemical or set of chemicals produced by a living organism that transmits a message to other members of the same species." Rather, Appellants' pheromones are "digital pheromones" (claims 1 and 21) that perform functions akin to a chemical pheromone, but in a digital space. An Applicant is entitled to be his own lexicographer. See *In re Paulsen*, 30 F.3d 1475, 1480, 31 USPQ2d 1671, 1674 (Fed. Cir. 1994).

Conclusion

In conclusion, for the arguments of record and the reasons set forth above, all pending claims of the subject application continue to be in condition for allowance and Appellant seeks the Board's concurrence at this time.

Serial No. 09/900,251

- 7 -

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Date: July 17, 2006

Respectfully submitted,

By: \_\_\_\_\_

John G. Posa

Reg. No. 37,424

Gifford, Krass, Groh, Sprinkle,  
Anderson & Citkowski, P.C.

PO Box 7021

Troy, MI 48007-7021

(734) 913-9300



**APPENDIX A**  
**CLAIMS ON APPEAL**

1. A system for constraining the movement of a walker in a digital space with respect to some distinguished location in said space, comprising:

a pump software component associated with the distinguished location emitting a digital pheromone to generate a pheromone gradient, said pheromone having a rate of evaporation and a rate of propagation and

a walker software component operating in a grid system within the space and having a pheromone sensing threshold, said walker moving within the space to satisfy a preselected constraint with respect to said pump.

2. The system of claim 1 wherein the space is two-dimensional.

3. The system of claim 1 wherein the space is selected from the group consisting of: virtual, three-dimensional and multi-dimensional with a dimensionality of greater than 3.

4. The system of claim 1 further comprising a plurality of said pumps.

5. The system of claim 1 wherein said pheromone is emitted at a fixed strength.

6. The system of claim 1 wherein said pheromone is emitted at regular intervals.

7. The system of claim 1 wherein said pump is stationary.

8. The system of claim 1 wherein said pump is mobile within the space.

9. The system of claim 1 wherein the rate of propagation is the same in all directions.



10. The system of claim 1 wherein the rate of propagation depends on a mesh of the grid system.
11. The system of claim 1 wherein the propagation is between 1 and 20 walker sensing steps.
12. The system of claim 1 wherein said grid system is selected from a group consisting of: trigonal, quadragonal, irregular, and hexagonal.
13. The system of claim 1 wherein the grid system is hexagonal.
14. The system of claim 1 wherein the preselected constraint relative to said pump is co-location.
15. The system of claim 1 wherein the preselected constraint relative to said pump is a spacing having a preselected pheromone concentration.
16. The system of claim 15 wherein the preselected pheromone concentration is above the pheromone sensing threshold of said walker.
17. The system of claim 15 wherein the preselected pheromone concentration is below the pheromone sensing threshold of said walker.
18. The system of claim 1 wherein said pump emits a plurality of pheromones, said plurality of pheromones having a plurality of rates of propagation and said walker senses each of said plurality of pheromones differently.
19. The system of claim 1 wherein said grid system is a multi-layer grid system.

20. The system of claim 19 wherein the multi-layer grid system comprises layers that vary in relative mesh.

21. A process for constraining the movement of a walker software component in a digital space with respect to some distinguished location in said space, comprising the steps of:

emitting a digital pheromone from a pump to generate a pheromone gradient, wherein said pheromone has a rate of evaporation and rate of propagation; and

moving said walker within the space in response to the pheromone gradient to satisfy a preselected constraint relative to said pump.

22. The process of claim 21 wherein the movement of said walker follows a polytopal grid system.

23. The process of claim 22 wherein the grid system is selected from a group consisting of trigonal, quadragonal, irregular, and hexagonal, .

24. The process of claim 23 wherein the grid system is hexagonal and a sum of said pheromone deposited in a grid system place that is reached from the pump's place  $p_0$  in  $d$  steps and the shortest path of the grid system,  $t$  time units after emission is computed recursively as

$$q(d,t) = \frac{F}{6} \left( \frac{2d-1}{d-1} q(d-1,t-1) + \frac{2d+1}{d+1} q(d+1,t-1) + 2q(d,t-1) \right)$$

where  $F$  relates to the strength of the pheromone emission.

25. The process of claim 21 wherein the movement of said walker further comprises the step of determining a selection probability for moving a grid system unit adjacent to a walker place.

26. The process of claim 25 wherein determining the selection probability further comprises the steps of:

sampling a concentration of said pheromone,  $s_i$  at each adjacent place  $p_i$ ; and

determining the relative attraction,  $f_i$  of an adjacent place normalized by an overall concentration of all places as given by the equation

$$f_i = s_i / \sum_{p_j \in C(p)} s_j$$

where  $C(p)$  is the current place of said walker and the directly adjacent grid system units of said walker and  $j$  denotes all grid system units sampled.

27. The process of claim 21 wherein emission of a pheromone further comprises emitting a second pheromone having a second propagation distance that varies from the propagation distance of said pheromone.

28. The process of claim 21 wherein the preselected location of said walker relative to said pump is co-location.

29. The process of claim 21 wherein emission of said pheromone is from a plurality of pumps within the space.

30. The process of claim 21 wherein movement of said walker in the space is random until said walker senses said pheromone gradient.

31. The process of claim 27 wherein the movement of said walker is along a multi-layer grid system.

32. The process of claim 31 wherein said second pheromone is emitted differentially within the multi-layer grid system relative to said pheromone.

33. The process of claim 31 further comprising the step of said walker following said second pheromone preferentially when remote from said pump and said pheromone preferentially when proximal to said pump.

34. A system for constraining the movement of a walker software component in a digital space with respect to some distinguished location in said space, comprising:

a pump software component;

a plurality of distance software agents created by said pump around a pump location, said plurality of distance agents depositing distance-pheromones having local concentrations forming a distance profile; and

a walker software component operating in a grid space of polytopes that samples the distance profiles to satisfy a preselected constraint relative to said pump.

35. The system of claim 34 wherein the space is two-dimensional.

36. The system of claim 34 wherein the space is selected from the group consisting of: virtual, three-dimensional and multi-dimensional with a dimensionality of greater than 3.

37. The system of claim 34 further comprising a plurality of said pumps.

38. The system of claim 34 wherein said pump is mobile within the space.

39. The system of claim 34 wherein the preselected constraint relative to said pump is co-location.

40. The system of claim 34 wherein said polygonal grid system is a multi-layer grid system.

Serial No. 09/900,251

- 13 -

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**APPENDIX B**

**EVIDENCE**

None.

Serial No. 09/900,251

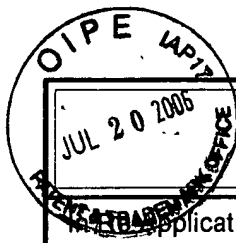
- 14 -

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**APPENDIX C**

**RELATED PROCEEDINGS**

None.



AF-131w

<b>TRANSMITTAL OF APPEAL BRIEF (Small Entity)</b>	Docket No. <b>ERIO-11302/03</b>
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Application Of: **Brueckner et al**

Application No. <b>09/900,251</b>	Filing Date <b>07/06/2001</b>	Examiner <b>Brian Sines</b>	Customer No. <b>25006</b>	Group Art Unit <b>1743</b>	Confirmation No. <b>5963</b>
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Invention: **SPATIAL COORDINATION SYSTEM**

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COMMISSIONER FOR PATENTS:

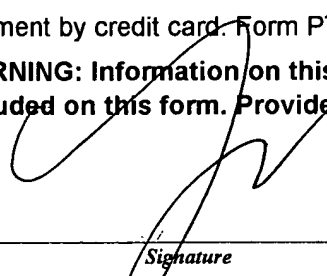
Transmitted herewith is the Appeal Brief in this application, with respect to the Notice of Appeal filed on:  
**May 15, 2006**

☒ Applicant claims small entity status. See 37 CFR 1.27

The fee for filing this Appeal Brief is: **\$250.00**

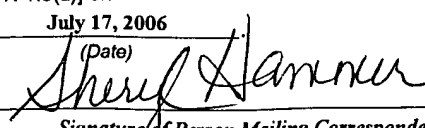
- ☒ A check in the amount of the fee is enclosed.
- ☐ The Director has already been authorized to charge fees in this application to a Deposit Account.
- ☒ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. 07-1180 . I have enclosed a duplicate copy of this sheet.
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Dated: **July 17, 2006**

**John G. Posa**  
Reg. No. 37,424  
Gifford, Krass, Groh, Sprinkle  
PO Box 7021  
Troy, MI 48007  
Tel. 734/913-9300

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